WHAT IS CLAIMED IS:

1. A method of producing a physiological response in an animal comprising administering to the animal a metal-containing nucleic acid duplex, wherein the metal-containing nucleic acid duplex comprises a first strand of nucleic acid and a second strand of nucleic acid, the first and the second nucleic acid strands each comprising a plurality of nitrogen-containing aromatic bases covalently linked by a backbone, the nitrogen-containing aromatic bases of the first nucleic acid strand being joined by hydrogen bonding to the nitrogen-containing aromatic bases of the second nucleic acid strand, the nitrogen-containing aromatic bases on the first and the second nucleic acid strands forming hydrogen-bonded base pairs in stacked arrangement along the length of the metal-containing nucleic acid duplex, at least some of the hydrogen-bonded base pairs comprising an interchelated divalent metal cation coordinated to a nitrogen atom in one of the aromatic nitrogen-containing aromatic bases.

2. The method of claim 1, wherein the physiological response is an immune response.

3. The method of claim 2, wherein the metal-containing nucleic acid expresses an antigenic protein in the animal to produce the immune response.

4. The method of claim 2, wherein the immune response produces antibodies to the metal-containing nucleic acid in the animal.

5. The method of claim 1, wherein the physiological response is an antisense response, wherein expression of the metal-containing nucleic acid inhibits the expression of a complementary gene, wherein the complementary gene has a sequence complementary to the first or second strand of the metal-containing nucleic acid.

6. The method of claim 1 wherein the first and the second nucleic acid strands are deoxyribonucleic acid and the nitrogen-containing aromatic bases are selected from the group consisting of adenine, thymine, guanine and cytosine.

7. The method of claim 1 wherein the divalent metal cation is selected from the group consisting of Zn^{2+}, Co^{2+}, and Ni^{2+}.

8. The method of claim 1 wherein the divalent metal cations are substituted for imine protons of the nitrogen-containing aromatic bases, and the nitrogen-containing aromatic bases are selected from the group consisting of thymine and guanosine.

9. The method of claim 1 wherein at least one of the aromatic nitrogen-containing aromatic bases is thymine, having an N3 nitrogen atom, and the divalent metal cation is coordinated by the N3 nitrogen atom.

10. The method of claim 1 wherein at least one of the aromatic nitrogen-containing aromatic bases is guanine, having an N1 nitrogen atom, and the divalent metal cation is coordinated by the N1 nitrogen atom.

11. The method of claim 1, wherein the metal-containing nucleic acid further comprises an electron source electrically coupled to the metal-containing nucleic acid duplex.

12. The method of claim 11, wherein the metal-containing nucleic acid further comprises an electron sink electrically coupled to the metal-containing nucleic acid duplex.

13. The method of claim 1, wherein the animal is a human.

14. A method of producing a physiological response in an animal comprising administering to the animal a metal-containing nucleic acid duplex, wherein the metal-containing nucleic acid duplex is made by a process comprising:

a) providing a nucleic acid duplex comprising a first strand of nucleic acid and a second strand of nucleic acid, the first and the second nucleic acid strands comprising a plurality of nitrogen-containing aromatic bases covalently linked by a backbone, the nitrogen-containing aromatic bases of the first nucleic acid strand being joined by hydrogen bonding to the nitrogen-containing aromatic bases of the second nucleic acid strand, the nitrogen-containing aromatic bases on the first and the second nucleic acid

strands forming hydrogen-bonded base pairs in stacked arrangement along the length of the nucleic acid duplex; and,

b) subjecting the nucleic acid duplex to a basic solution in the presence of a divalent metal cation under conditions effective to form a conductive metal-containing nucleic acid duplex, wherein at least some of the hydrogen-bonded base pairs of the conductive metal-containing nucleic acid duplex comprise an interchelated divalent metal cation coordinated to a nitrogen atom in one of the aromatic nitrogen-containing aromatic bases.

15. The method of claim 14, wherein the physiological response is an immune response.

16. The method of claim 15, wherein the metal-containing nucleic acid expresses an antigenic protein in the animal to produce the immune response.

17. The method of claim 15, wherein the immune response produces antibodies to the metal-containing nucleic acid in the animal.

18. The method of claim 14 wherein the first and the second nucleic acid strands are deoxyribonucleic acid and the nitrogen-containing aromatic bases are selected from the group consisting of adenine, thymine, guanine and cytosine.

19. The method of claim 14 wherein the divalent metal cation is selected from the group consisting of Zn^{2+}, Co^{2+}, and Ni^{2+}.

20. The method of claim 14 wherein the divalent metal cations are substituted for imine protons of the nitrogen-containing aromatic bases, and the nitrogen-containing aromatic bases are selected from the group consisting of thymine and guanosine.

21. The method of claim 14 wherein at least one of the aromatic nitrogen-containing aromatic bases is thymine, having an N3 nitrogen atom, and the divalent metal cation is coordinated by the N3 nitrogen atom.

22. The method of claim 14 wherein at least one of the aromatic nitrogen-containing aromatic bases is guanine, having an N1 nitrogen atom, and the divalent metal cation is coordinated by the N1 nitrogen atom.